

(e) We may require you to test another engine of the same or different configuration in addition to the engine(s) tested under paragraph (b) of this section.

(f) If you use an alternate test procedure under 40 CFR 1065.10 and later testing shows that such testing does not produce results that are equivalent to the procedures specified in subpart F of this part, we may reject data you generated using the alternate procedure.

(g) Measure CO<sub>2</sub> and CH<sub>4</sub> with each low-hour certification test using the procedures specified in 40 CFR part 1065 starting in the 2011 and 2012 model years, respectively. Also measure N<sub>2</sub>O with each low-hour certification test using the procedures specified in 40 CFR part 1065 starting in the 2013 model year for any engine family that depends on NO<sub>x</sub> aftertreatment to meet emission standards. Small-volume engine manufacturers may omit measurement of N<sub>2</sub>O and CH<sub>4</sub>. These measurements are not required for NTE testing. Use the same units and modal calculations as for your other results to report a single weighted value for each constituent. Round the final values as follows:

- (1) Round CO<sub>2</sub> to the nearest 1 g/kW-hr.
- (2) Round N<sub>2</sub>O to the nearest 0.001 g/kW-hr.
- (3) Round CH<sub>4</sub> to the nearest 0.001 g/kW-hr.

[73 FR 59194, Oct. 8, 2008, as amended at 74 FR 56510, Oct. 30, 2009]

**§ 1045.240 How do I demonstrate that my engine family complies with exhaust emission standards?**

(a) For purposes of certification, your engine family is considered in compliance with the duty-cycle emission standards in § 1045.103 or § 1045.105 if all emission-data engines representing that family have test results showing official emission results and deteriorated emission levels at or below these standards. This also applies for all test points for emission-data engines within the family used to establish deterioration factors. Note that your FELs are considered to be the applicable emission standards with which you must comply if you participate in the ABT

program in subpart H of this part. See paragraph (e) of this section for provisions related to demonstrating compliance with NTE standards.

(b) Your engine family is deemed not to comply with the duty-cycle emission standards in § 1045.103 or § 1045.105 if any emission-data engine representing that family has test results showing an official emission result or a deteriorated emission level for any pollutant that is above an applicable emission standard. Similarly, your engine family is deemed not to comply if any emission-data engine representing that family has test results showing any emission level above the applicable not-to-exceed emission standard for any pollutant. This also applies for all test points for emission-data engines within the family used to establish deterioration factors.

(c) Determine a deterioration factor to compare emission levels from the emission-data engine with the applicable emission standards. Section 1045.245 specifies how to test engines to develop deterioration factors that represent the expected deterioration in emissions over your engines' full useful life. Your deterioration factors must take into account any available data from in-use testing with similar engines. You may ask us to give you an assigned deterioration factor for your high-performance engines. Small-volume engine manufacturers may use assigned deterioration factors that we establish for any engine families certified under this part. Apply deterioration factors as follows:

(1) *Additive deterioration factor for exhaust emissions.* For engines that do not use aftertreatment technology, use an additive deterioration factor for exhaust emissions. An additive deterioration factor is the difference between exhaust emissions at the end of useful life and exhaust emissions at the low-hour test point. Adjust the official emission results for each tested engine at the selected test point by adding the factor to the measured emissions. If the deterioration factor is less than zero, use zero. Additive deterioration factors must be specified to one more decimal place than the emission standard.

(2) *Multiplicative deterioration factor for exhaust emissions.* For engines that use aftertreatment technology, such as catalytic converters, use a multiplicative deterioration factor for exhaust emissions. A multiplicative deterioration factor is the ratio of exhaust emissions at the end of useful life to exhaust emissions at the low-hour test point. Adjust the official emission results for each tested engine at the selected test point by multiplying the measured emissions by the deterioration factor. If the deterioration factor is less than one, use one. Multiplicative deterioration factors must be specified to one more significant figure than the emission standard.

(d) Collect emission data using measurements to one more decimal place than the applicable standard. Apply the deterioration factor to the official emission result, as described in paragraph (c) of this section, then round the adjusted figure to the same number of decimal places as the emission standard. Compare the rounded emission levels to the emission standard for each emission-data engine. In the case of HC+NO<sub>x</sub> standards, add the official emission results and apply the deterioration factor to the sum of the pollutants before rounding. However, if your deterioration factors are based on emission measurements that do not cover the vehicle's full useful life, apply the deterioration factor to each pollutant and then add the results before rounding.

(e) Use good engineering judgment to demonstrate compliance with NTE standards throughout the useful life. You may, but are not required to, apply the same deterioration factors used to show compliance with the applicable duty-cycle standards.

[73 FR 59194, Oct. 8, 2008, as amended at 75 FR 23019, Apr. 30, 2010]

**§ 1045.245 How do I determine deterioration factors from exhaust durability testing?**

This section describes how to determine deterioration factors, either with pre-existing test data or with new emission measurements.

(a) You may ask us to approve deterioration factors for an engine family based on emission measurements from

similar engines if you have already given us these data for certifying the other engines in the same or earlier model years. Use good engineering judgment to decide whether the two engines are similar.

(b) If you are unable to determine deterioration factors for an engine family under paragraph (a) of this section, select engines, subsystems, or components for testing. Determine deterioration factors based on service accumulation and related testing. Include consideration of wear and other causes of deterioration expected under typical consumer use, including exposure to saltwater if applicable. Determine deterioration factors as follows:

(1) You must measure emissions from the emission-data engine at a low-hour test point and the end of the useful life. You may also test at evenly spaced intermediate points. Collect emission data using measurements to one more decimal place than the emission standard.

(2) Operate the engine over a representative duty cycle for a period at least as long as the useful life (in hours). You may operate the engine continuously. You may also use an engine installed in a vessel to accumulate service hours instead of running the engine only in the laboratory.

(3) In the case of dual-fuel or flexible-fuel engines, you may accumulate service hours on a single emission-data engine using the type or mixture of fuel expected to have the highest combustion and exhaust temperatures. For dual-fuel engines, you must measure emissions on each fuel type at each test point.

(4) You may perform maintenance on emission-data engines as described in § 1045.125 and 40 CFR part 1065, subpart E.

(5) If you measure emissions at only two points to calculate your deterioration factor, base your calculations on a linear relationship connecting these two data points for each pollutant. If you measure emissions at three or more points, use a linear least-squares fit of your test data for each pollutant to calculate your deterioration factor.

(6) If you test more than one engine to establish deterioration factors, calculate the deterioration factor for each